The Embedded I/O Company

TEWS TECHNOLOGIES

TPMC316

Conduction Cooled

CAN Bus PMC Module

Version 1.0

User Manual

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TPMC316-10

Conduction cooled CAN bus PMC module with CAN High Speed interface

TPMC316-11

Conduction cooled CAN bus PMC module with modified RS485 interface

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Style Conventions

Hexadecimal characters are specified with prefix 0x, i.e. 0x029E (that means hexadecimal value 029E).

For signals on hardware products, an ‚Active Low' is represented by the signal name with # following, i.e. IP_RESET#.

Access terms are described as:

W	Write Only
R	Read Only
R/W	Read/Write
R/C	Read/Clear
R/S	Read/Set

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Issue	Description	Date
1.0	First Issue	August 2000
1.1	Change default values for Hot Swap Register	June 2002
1.2	General Revision	May 2003
1.3	New Hardware Revision	July 2006
1.4	New address TEWS LLC	September 2006
1.0.5	(1) New Notation for User Manual and Engineering Documentation (2) Added Note for TPMC316-10 Min. Baud Rate in the Technical Specification Table	February 2010

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1 Product Description

The TPMC316 is a conduction cooled single-width 32 bit PMC module and provides two complete CAN bus interfaces using two Intel 82527 CAN controllers. Both channels are completely independent and support CAN specification 2.0 part A and B (standard 11 bit identifier and extended 29 bit identifier).

Each physical interface is optically isolated from the CAN controller and powered by an on board DC/DC converter and a voltage regulator. Two versions of physical interface are available: the TPMC316-10 supports CAN high speed for each of the two channels. The TPMC316-11 provides a modified RS485 interface for each of the two channels. The bus line termination can be enabled or disabled for each channel by solder pads (disabled per default).

The TPMC316 has no front panel. It uses P14 I/O connector with the same pin assignment as the TPMC816.

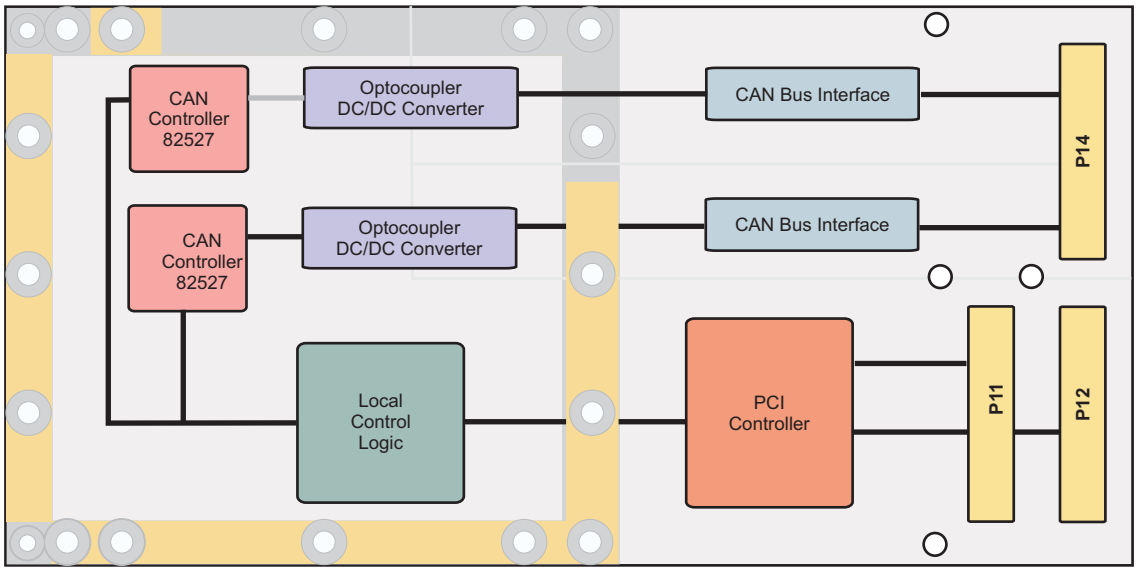

Figure 1-1 : Block Diagram

2 Technical Specification

PMC Interface		
Mechanical Interface	PCI Mezzanine Card (PMC) Interface Single Size	
Electrical Interface	PCI Rev. 2.1 compliant 33 MHz / 32 bit PCI 3.3V and 5V PCI Signaling Voltage	
On Board Devices		
PCI Target Chip	PCI9030 (PLX Technology)	
CAN Controller	Intel 82527	
I/O Interface		
Number of Channels	2	
Physical Interface	TPMC316-10: CAN High Speed (according to ISO 11898) TPMC316-11: modified RS485	
Bus Line Termination	On board 120 ohms, disabled per default	
Transfer Rate	Up to 1 Mbps at bus line length of up to 40 m Minimum Baud Rate for the TPMC316-10 is 60 Kbps (TJA1050 CAN Transceiver Timeout Feature)	
Isolation	CAN bus isolated by optocouplers and DC/DC converter for each channel	
I/O Connector	PMC P14 I/O (64 pin Mezzanine Connector)	
Physical Data		
Power Requirements	120mA typical @ +3.3V DC 200mA typical @ +5V DC Note: Both CAN channels connect to each other and termination active.	
Temperature Range	Operating Storage	-40 °C to +85 °C -40°C to +85°C
MTBF	TPMC316-10: 840000 h TPMC316-11: 821000 h	
Humidity	5 – 95 % non-condensing	
Weight	61 g	

Table 2-1 : Technical Specification

3 Local Space Addressing

3.1 PCI9030 Local Space Configuration

The local on board addressable regions are accessed from the PCI side by using the PCI9030 local spaces.

PCI9030 Local Space	PCI9030 PCI Base Address (Offset in PCI Configuration Space)	PCI Space Mapping	Size (Byte)	Port Width (Bit)	Endian Mode	Description
0	0 (0x10)	MEM	128	32	LITTLE	Local Configuration Registers
1	1(0x14)	I/O	128	32	LITTLE	Local Configuration Registers
2	2 (0x18)	MEM	512	8	LITTLE	Local Address Space 0
3	3 (0x1C)	-	-	-	-	Local Address Space 1
4	4 (0x20)	-	-	-	-	Local Address Space 2
5	5 (0x24)	-	-	-	-	Local Address Space 3
6	6 (0x30)	-	-	-	-	Local Expansion ROM Space

Table 3-1 : PCI9030 Local Space Configuration

3.2 Local Address Space 0

The complete register sets of the two CAN controllers of the TPMC316 are accessible in the memory space of the PMC module.

Address range: PCI Base Address 2 for Local Address Space 0 + (0x0000 to 0x00FF)

CAN Controller channel 0 CANCH0: PCI Base Address 2 + (0x0000 to 0x00FF)

CAN Controller channel 1 CANCH1: PCI Base Address 2 + (0x0100 to 0x01FF)

3.3 CAN Controller Address Map

Address	Description
CAN Controller Channel 0 CANCH0	
0x0000	Control Register
0x0001	Status Register
0x0002	CPU Interface Register
0x0003	Reserved
0x0004-0x0005	High Speed Read Register
0x0006-0x0007	Global Mask – Standard
0x0008-0x000B	Global Mask – Extended
0x000C-0x000F	Message 15 Mask
0x0010-0x001E	Message 1
0x001F	CLKOUT Register
0x0020-0x002E	Message 2
0x002F	Bus Configuration Register
0x0030-0x003E	Message 3
0x003F	Bit Timing Register 0
0x0040-0x004E	Message 4
0x004F	Bit Timing Register 1
0x0050-0x005E	Message 5
0x005F	Interrupt Register
0x0060-0x006E	Message 6
0x006F	Reserved
0x0070-0x007E	Message 7
0x007F	Reserved
0x0080-0x008E	Message 8
0x008F	Reserved
0x0090-0x009E	Message 9
0x009F	P1CONF
0x00A0-0x00AE	Message A
0x00AF	P2CONF
0x00B0-0x00BE	Message B
0x00BF	P1IN
0x00C0-0x00CE	Message C
0x00CF	P2IN
0x00D0-0x00DE	Message D
0x00DF	P1OUT
0x00E0-0x00EE	Message E
0x00EF	P2OUT

Address	Description
0x00F0-0x00FE	Message F
0x00FF	Serial Reset Address

Table 3-2 : Memory Address Map CAN Controller Channel 0 CANCH0

Address	Description
CAN Controller Channel 1 CANCH1	
0x0000	Control Register
0x0101	Status Register
0x0102	CPU Interface Register
0x0103	Reserved
0x0104-0x0105	High Speed Read Register
0x0106-0x0107	Global Mask – Standard
0x0108-0x010B	Global Mask – Extended
0x010C-0x010F	Message 15 Mask
0x0110-0x011E	Message 1
0x011F	CLKOUT Register
0x0120-0x012E	Message 2
0x012F	Bus Configuration Register
0x0130-0x013E	Message 3
0x013F	Bit Timing Register 0
0x0140-0x014E	Message 4
0x014F	Bit Timing Register 1
0x0150-0x015E	Message 5
0x015F	Interrupt Register
0x0160-0x016E	Message 6
0x016F	Reserved
0x0170-0x017E	Message 7
0x017F	Reserved
0x0180-0x018E	Message 8
0x018F	Reserved
0x0190-0x019E	Message 9
0x019F	P1CONF
0x01A0-0x01AE	Message A
0x01AF	P2CONF
0x01B0-0x01BE	Message B
0x01BF	P1IN
0x01C0-0x01CE	Message C
0x01CF	P2IN

Address	Description
0x01D0-0x01DE	Message D
0x01DF	P1OUT
0x01E0-0x01EE	Message E
0x01EF	P2OUT
0x01F0-0x01FE	Message F
0x01FF	Serial Reset Address

Table 3-3 : Memory Address Map CAN Controller Channel 1 CANCH1

4 PCI9030 Target Chip

4.1 PCI Configuration Registers (CFG)

4.1.1 PCI9030 Header

PCI CFG Register Address	Write '0' to all unused (Reserved) bits				PCI writeable	Initial Values (Hex Values)
	31 24	23 16	15 8	7 0		
0x00	Device ID		Vendor ID		N	013C 1498
0x04	Status		Command		Y	0280 0000
0x08	Class Code			Revision ID	N	028000 0A
0x0C	BIST	Header Type	PCI Latency Timer	Cache Line Size	Y[7:0]	00 00 00 00
0x10	PCI Base Address 0 for MEM Mapped Config. Registers				Y	FFFFFF80
0x14	PCI Base Address 1 for I/O Mapped Config. Registers				Y	FFFFFF81
0x18	PCI Base Address 2 for Local Address Space 0				Y	FFFFFE00
0x1C	PCI Base Address 3 for Local Address Space 1				Y	00000000
0x20	PCI Base Address 4 for Local Address Space 2				Y	00000000
0x24	PCI Base Address 5 for Local Address Space 3				Y	00000000
0x28	PCI CardBus Information Structure Pointer				N	00000000
0x2C	Subsystem ID		Subsystem Vendor ID		N	000A 1498
0x30	PCI Base Address for Local Expansion ROM				Y	00000000
0x34	Reserved			New Cap. Ptr.	N	000000 40
0x38	Reserved				N	00000000
0x3C	Max_Lat	Min_Gnt	Interrupt Pin	Interrupt Line	Y[7:0]	00 00 01 00
0x40	PM Cap.		PM Nxt Cap.	PM Cap. ID	N	4801 48 01
0x44	PM Data	PM CSR EXT	PM CSR		Y	00 00 0000
0x48	Reserved	HS CSR	HS Nxt Cap.	HS Cap. ID	Y[23:16]	00 00 0000
0x4C	VPD Address		VPD Nxt Cap.	VPD Cap. ID	Y[31:16]	0000 00 03
0x50	VPD Data				Y	00000000

Table 4-1 : PCI9030 Header

4.1.2 PCI Base Address Initialization

PCI Base Address Initialization is scope of the PCI host software.

PCI9030 PCI Base Address Initialization:

1. Write 0xFFFF_FFFF to the PCI9030 PCI Base Address Register.
2. Read back the PCI9030 PCI Base Address Register.
3. For PCI Base Address Registers 0:5, check bit 0 for PCI Address Space.

   Bit 0 = '0' requires PCI Memory Space mapping

   Bit 0 = '1' requires PCI I/O Space mapping

   For the PCI Expansion ROM Base Address Register, check bit 0 for usage.

   Bit 0 = ‘0’: Expansion ROM not used

   Bit 0 = ‘1’: Expansion ROM used
4. For PCI I/O Space mapping, starting at bit location 2, the first bit set determines the size of the required PCI I/O Space size.

   For PCI Memory Space mapping, starting at bit location 4, the first bit set to '1' determines the size of the required PCI Memory Space size.

   For PCI Expansion ROM mapping, starting at bit location 11, the first bit set to '1' determines the required PCI Expansion ROM size.

   For example, if bit 5 of a PCI Base Address Register is detected as the first bit set to ‘1’, the PCI9030 is requesting a 32 byte space (address bits 4:0 are not part of base address decoding).
5. Determine the base address and write the base address to the PCI9030 PCI Base Address Register. For PCI Memory Space mapping the mapped address region must comply with the definition of bits 3:1 of the PCI9030 PCI Base Address Register.

After programming the PCI9030 PCI Base Address Registers, the software must enable the PCI9030 for PCI I/O and/or PCI Memory Space access in the PCI9030 PCI Command Register (Offset 0x04). To enable PCI I/O Space access to the PCI9030, set bit 0 to '1'. To enable PCI Memory Space access to the PCI9030, set bit 1 to '1'.

Offset in Config.	Description	Usage
0x10	PCI9030 LCR’s MEM	Used
0x14	PCI9030 LCR’s I/O	Used
0x18	PCI9030 Local Space 0	Used
0x1C	PCI9030 Local Space 1	Not used
0x30	Expansion ROM	Not used

Table 4-2 : PCI9030 Base Address Usage

4.2 Local Configuration Register (LCR)

After reset, the PCI9030 Local Configuration Registers are loaded from the on board serial configuration EEPROM.

The PCI base address for the PCI9030 Local Configuration Registers is PCI9030 PCI Base Address 0 (PCI Memory Space) (Offset 0x10 in the PCI9030 PCI Configuration Register Space) or PCI9030 PCI Base Address 1 (PCI I/O Space) (Offset 0x14 in the PCI9030 PCI Configuration Register Space).

Do not change hardware dependent bit settings in the PCI9030 Local Configuration Registers.

Offset from PCI Base Address	Register	Value	Description
0x00	Local Address Space 0 Range	0x0FFFFFF0	Memory Space CAN
0x04	Local Address Space 1 Range	0x0FFFFFC0	Not used
0x08	Local Address Space 2 Range	0x0FFFFE00	Not used
0x0C	Local Address Space 3 Range	0x00000000	Not used
0x10	Local Exp. ROM Range	0x00000000	Not used
0x14	Local Re-map Register Space 0	0x00000001	Enabled, Offset 0
0x18	Local Re-map Register Space 1	0x00001001	Not used
0x1C	Local Re-map Register Space 2	0x00002001	Not used
0x20	Local Re-map Register Space 3	0x00000000	Not used
0x24	Local Re-map Register ROM	0x00000000	Not used
0x28	Local Address Space 0 Descriptor	0x1500C0A0	Local Timing
0x2C	Local Address Space 1 Descriptor	0x1580C062	Not used
0x30	Local Address Space 2 Descriptor	0x15024120	Not used
0x34	Local Address Space 3 Descriptor	0x00000000	Not used
0x38	Local Exp. ROM Descriptor	0x00000000	Not used
0x3C	Chip Select 0 Base Address	0x00000009	Chip select CAN0
0x40	Chip Select 1 Base Address	0x00001021	Chip select CAN1
0x44	Chip Select 2 Base Address	0x00002081	Not used
0x48	Chip Select 3 Base Address	0x00002181	Not used
0x4C	Interrupt Control/Status	0x0041	Interrupt Configuration
0x4E	EEPROM Write Protect Boundary	0x0030	No write protection
0x50	Miscellaneous Control Register	0x00780000	Retry Delay = max.
0x54	General Purpose I/O Control	0x026DB6D2	All pins are outputs
0x70	Hidden1 Power Management data select	0x00000000	Not used
0x74	Hidden 2 Power Management data scale	0x00000000	Not used

Table 4-3 : PCI9030 Local Configuration Register

4.3 Configuration EEPROM

After power-on or PCI reset, the PCI9030 loads initial configuration register data from the on board configuration EEPROM.

The configuration EEPROM contains the following configuration data:

- Address 0x00 to 0x27 : PCI9030 PCI Configuration Register Values
- Address 0x28 to 0x87 : PCI9030 Local Configuration Register Values

See the PCI9030 Manual for more information.

Address	Offset							
	0x00	0x02	0x04	0x06	0x08	0x0A	0x0C	0x0E
0x00	0x013C	0x1498	0x0280	0x0000	0x0280	0x000A	s.b.	0x1498
0x10	0x0000	0x0040	0x0000	0x0100	0x4801	0x4801	0x0000	0x0000
0x20	0x0000	0x4C06	0x0000	0x0003	0x0FFF	0xFE00	0x0000	0x0000
0x30	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0001
0x40	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
0x50	0x5400	0xC042	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
0x60	0x0000	0x0000	0x0000	0x0081	0x0000	0x0181	0x0000	0x0000
0x70	0x0000	0x0000	0x0030	0x0049	0x0078	0x0000	0x0224	0xA492
0x80	0x0000	0x0000	0x0000	0x0000	0xFFFF	0xFFFF	0xFFFF	0xFFFF
0x90	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF
0xA0	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF
0xB0	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF
0xC0	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF
0xD0	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF
0xE0	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF
0xF0	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF	0xFFFF

Table 4-4 : Configuration EEPROM TPMC316-xx

Subsystem-ID Value (Offset 0x0C): TPMC316-10 0x000A

TPMC316-11 0x000B

5 Configuration Hints

5.1 PCI Interrupt Control/Status

Both CAN controllers generate interrupts at pin INTA# of the PCI bus. The interrupt status can be read at the Interrupt Status Register INTCSR of the PCI controller PCI9030.

Bit	Description	Access	Reset Value
31:8	unused	R	0
7	Software Interrupt	R/W	0
6	PCI Interrupt Enable	R/W	1
5	CAN Controller 1 Interrupt Status	R	0
4	Local Interrupt 2 Polarity	R/W	0
3	Local Interrupt 2 Enable	R/W	1
2	CAN Controller 0 Interrupt Status	R	0
1	Local Interrupt 1 Polarity	R/W	0
0	Local Interrupt 1 Enable	R/W	1

Table 5-1 : Interrupt Control/Status Register (INTCSR; 0x4C)

5.2 Local Software Reset

The PCI9030 Local Reset Output LRESETo# is used to reset the on board local logic.

The PCI9030 local reset is active during PCI reset or if the PCI Adapter Software Reset bit is set in the PCI9030 local configuration register CNTRL (offset 0x50).

CNTRL[30] PCI Adapter Software Reset:

Value of ‘1’ resets the PCI9030 and issues a reset to the Local Bus (LRESETo# asserted). The PCI9030 remains in this reset condition until the PCI Host clears this bit. The contents of the PCI9030 PCI and Local Configuration Registers are not reset. The PCI9030 PCI Interface is not reset.

5.3 Big / Little Endian

- PCI – Bus (Little Endian)

Byte 0	AD[7..0]
Byte 1	AD[15..8]
Byte 2	AD[23..16]
Byte 3	AD[31..24]

- Every Local Address Space (0...3) and the Expansion ROM Space can be programmed to operate in Big or Little Endian Mode.

Big Endian		**Little Endian**	
32 Bit		**32 Bit**	
Byte 0	D[31..24]	Byte 0	D[7..0]
Byte 1	D[23..16]	Byte 1	D[15..8]
Byte 2	D[15..8]	Byte 2	D[23..16]
Byte 3	D[7..0]	Byte 3	D[31..24]
16 Bit upper lane		**16 Bit**	
Byte 0	D[31..24]	Byte 0	D[7..0]
Byte 1	D[23..16]	Byte 1	D[15..8]
16 Bit lower lane			
Byte 0	D[15..8]		
Byte 1	D[7..0]		
8 Bit upper lane		**8 Bit**	
Byte 0	D[31..24]	Byte 0	D[7..0]
8 Bit lower lane			
Byte 0	D[7..0]		

Table 5-2 : Local Bus Little/Big Endian

Standard use of the TPMC316:

Local Address Space 0	16 bit bus in Little Endian Mode
Local Address Space 1	not used
Local Address Space 2	not used
Local Address Space 3	not used
Expansion ROM Space	not used

To change the Endian Mode use the Local Configuration Registers for the corresponding Space. Bit 24 of the according register sets the mode. A value of 1 indicates Big Endian and a value of 0 indicates Little Endian.

For further information please refer to the PCI9030 manual which is also part of the TPMC316-ED Engineering Documentation.

Use the PCI Base Address 0 + Offset or PCI Base Address 1 + Offset:

Short cut Offset	Name	
LAS0BRD	0x28	Local Address Space 0 Bus Region Description Register
LAS1BRD	0x2C	Local Address Space 0 Bus Region Description Register
LAS2BRD	0x30	Local Address Space 0 Bus Region Description Register
LAS3BRD	0x34	Local Address Space 0 Bus Region Description Register
EROMBRD	0x38	Expansion ROM Bus Region Description Register

You could also use the PCI - Base Address 1 I/O Mapped Configuration Registers.

6 Installation

6.1 CAN bus Termination

Each end of a CAN bus must be terminated by a 120 ohms resistor between the CAN bus lines CAN high and CAN low.

This termination could be activated by closing the soldering connection LB2 and LB1. There is one solder connection for each channel.

Solder connection LB2 closed: bus line termination for CAN bus channel 0 active

Solder connection LB1 closed: bus line termination for CAN bus channel 1 active.

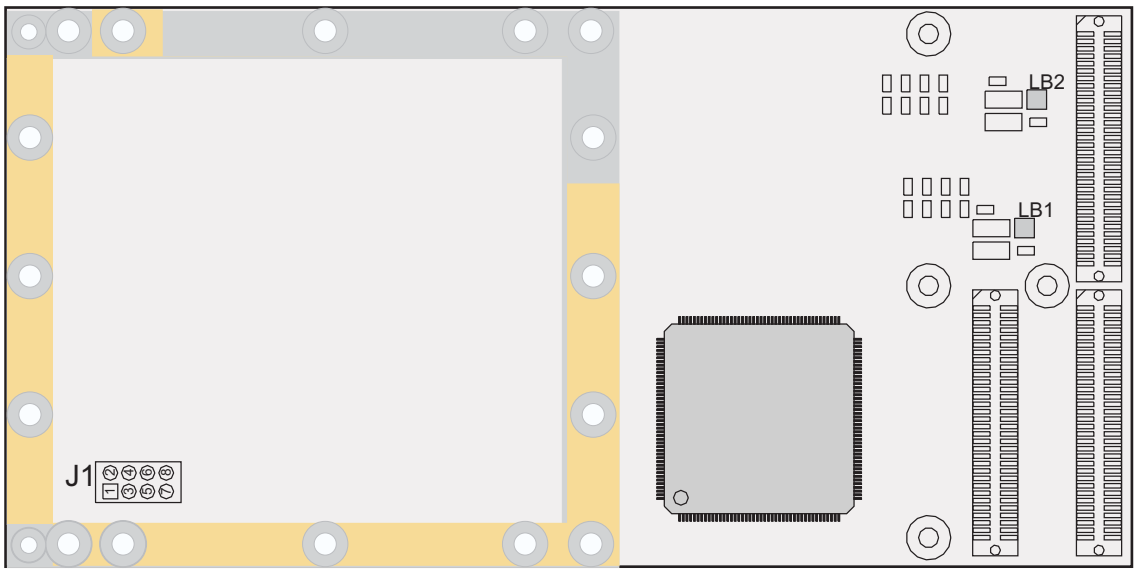

Figure 6-1 : Soldering Connection Location LB1 – LB2

6.2 Physical Interface

The TPMC316-10 provides a CAN High Speed interface and the TPMC316-11 a modified RS485 interface.

7 Pin Assignment – I/O Connector

7.1 Mezzanine Card Connector P14

Pin	Signal	Function
1	NC	
2	Ground channel 0	
3	Low level CAN voltage input/output channel 0	CAN High Speed or modified RS485
4	High level CAN voltage input/output channel 0	CAN High Speed or modified RS485
5	Ground channel 0	
6	NC	
7	NC	
8	NC	
9	NC	
10	NC	
11	Ground channel 1	
12	Low level CAN voltage input/output channel 1	CAN High Speed or modified RS485
13	High level CAN voltage input/output channel 1	CAN High Speed or modified RS485
14	Ground channel 1	
15	NC	
16…32	NC	

Table 7-1 : Mezzanine P14 Connector